DOCUMENT RESUME

ED 132 165 TM 005 856

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TITLE Mathematics Accountability Model Final Evaluation Report.
INSTITUTION Phoenix Union High School District, Ariz. Dept. of Research and Planning.
PUB DATE Jun 76
NOTE 15p.

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS Basic Skills; *Curriculum Development; *Curriculum Evaluation; Educational Accountability; Elementary Secondary Education; Evaluation Methods; Federal Programs; *Individualized Instruction; Instructional Materials; *Mathematics Curriculum; Models; Program Effectiveness; Student Attitudes; Student Evaluation
IDENTIFIERS Arizona (Phoenix); Mathematics Accountability Model; Phoenix Union High School District

ABSTRACT

The Mathematics Accountability Model (MAM) Project has succeeded in the development, implementation, evaluation, and dissemination of a completely individualized learning program for basic and higher order math skills. Student interest and achievement in the MAM Project are well documented exemplars of its success. It is recommended that the Phoenix Union High School System and the Arizona State Department of Education continue to support the expansion of the MAM to other schools and districts. The MAM can be recommended as an effective individualized learning program that provides for a continuous uniform evaluation system in basic and higher order mathematics skills (RC)

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ED132165

MATHEMATICS ACCOUNTABILITY MODEL

FINAL EVALUATION REPORT

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Introduction

As a major part of the Mathematics Accountability Model End of Project Report the subsequent pages contain the following elements which comprise the Final Evaluation Report.

First, the Program Description is presented to provide a description of the ESEA Title III Project.

The Evaluation Design presents some remarks regarding those general parameters of the evaluation and the methods to be used in evaluating objectives.

Finally, the Evaluation of Objectives presents a review of each objective area. The evaluation was not restricted to the third year activities. Instead a summary of evaluation of Mathematics Accountability Model Project over the past three years is included for each of the major objectives.

Program Description

There is an increasing emphasis upon accountability within the public school systems. The Arizona State Board of Education was given a legislative mandate which states:

> *By June 30, 1975, in cooperation with all local districts, develop, establish, and direct the implementation of a continuous uniform evaluation system of achievements in relation to measurable performance objectives in basic subjects. Title 15 ARS 15-102.*

This mandate is an example of the relation generally established between the concepts of evaluation and accountability. The purpose of accountability or evaluation within an educational system is to improve and provide the best possible education for pupils. This perception of

evaluation and accountability goes beyond a simple assessment and includes evaluation as an integral part of program modification and development.

The MAM is an ESEA Title III Project. It was designed (1) to provide an evaluation system in the area of mathematics which would meet the requirements of the State mandate, (2) to develop and implement a program in basic and higher order mathematical skills which would provide alternate learning procedures and individualized instruction, (3) to assist students in improving their basic computational skills, and (4) to improve students' attitudes toward math and quantitative thinking. In summary, the MAM program was developed for the purpose of providing a completely individualized program in basic mathematics skills with a continuous evaluation system.

The MAM Program is similar to other programs in that it uses a team-teaching approach. However, it is dissimilar to other programs in the individualized learning procedures provided. Essentially, the program has identified skills to be included in a basic computational skills program. The basic skills are similar to those found in "general math" programs. However, the skills identified within the MAM Program go beyond those found within a general math curriculum and include more complex math skills.

The MAM staff has developed instruments for assessing the skill competencies of the learners. The instruments enable a learner to know exactly which skills have been mastered and which skills need further work. This portion or aspect of the MAM provides for the continuous uniform evaluation system mandated by the State of Arizona.

The MAM Program does not end with the evaluation of the learners. Alternate learning procedures have been developed for each of the skills

or topics in the MAM Program. A learner proceeds in the MAM Program by identifying with pretests those areas in need of work, choosing with the assistance of an instructor those learning activities to be used in acquiring those skills, and taking a posttest to ascertain if he has acquired those skills. The term alternate procedures is not used superficially. There are different sets or practices and instructional materials for learning a particular skill or topic. The materials include cassette recordings corresponding to exercises in textbooks, Math Paths which contain several activities for each skill area, and math games which assist learners with their math skills.

Pupils studying the same areas are grouped together but this is not to the detriment of individualization. The grouping does not decrease the emphasis upon individualization and allowing each student to work at his own rate. Each learner works on those skills identified as areas in need of more work before mastery.

Evaluation Design

The evaluation design for the final year of the MAM will address the accomplishments and findings for the past three years and will not be limited to the third year activities. The first year was primarily a developmental year with emphasis placed upon the curriculum, materials, and training needed to implement an accountability model. The second year was a year in which material development continued and the MAM was implemented with an experimental design to assess the impact of the model on students' cognitive and affective achievements. The third year was devoted to the development of materials and products which will enable others to implement the MAM within a K-12 system.

The evaluation design for the developmental aspects of the program will summarize those materials and procedures which have been produced during the past three years. Past evaluation reports, materials and documents which have been produced, and observations of the evaluator serve as the basis for comments. Implementation of the MAM was described in the 1974-75 evaluation and audit reports. Data contained in those reports combined with observations of the evaluator in site visits in 1975-76 will be the basis for the summary evaluation for implementation. A summary of the findings in the 1974-75 product evaluation will serve as the basis for documenting the effectiveness of the program. Finally, the anticipated continuation and adoption of the MAM will be documented by materials which have been developed and future plans for continuation of the MAM.

It is anticipated this evaluation report will give a concise and accurate reporting of the MAM over the past three years. Readers interested in additional imformation are referred to the completed evaluation reports, audit reports, and project reports for the past three years.

Evaluation of Objectives

Program Development

The objective for program development was:

1.1 *Given eleven months planning time, materials, supplies, and support requirements, the Coordinator shall formulate an accountability model in mathematics.*

The final evaluation report for the 1973-74 MAM Project stated that there was evidence to indicate that the following activities were accomplished as part of the development of the MAM.

1. Identification of entry level behaviors of project participants.
2. Identification of desired terminal behaviors of project participants.
3. Implementation of a system which provides feedback on the teaching techniques and activities employed to move from entry level behaviors to desired terminal behaviors.
4. Identification of teacher behaviors or activities which are believed to have a maximum probability of increasing students' success for reaching terminal behaviors.
5. Construction and implementation of an observation schedule.
6. Establishment and implementation of an inservice schedule.
7. Writing and use of performance objectives and criterion-referenced tests for general mathematics.
8. Development of some curriculum materials, activities, resource materials, and special projects which provide alternate learning experiences in mathematics for participating population.
9. Writing and administering of attitude questionnaire to all accountability students to assess attitudes toward mathematics learning and instruction.
10. Establishment of Minimal Performance standards in Mathematics for high school graduation.

In addition to these activities the criterion-referenced instruments to be used within the MAM project were field-tested and revised; instructional materials were produced and made ready for use in the classroom; and a master plan for implementation was developed. The development of materials was continued during the second year in which further revisions and additions were made to the Group I performance objectives, and the Group II and III performance objectives were also developed and pilot-tested.[1]

Final program development was accomplished in 1975-76 with organization of materials into a systematic retrieval system, the

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[1]Group I objectives are basic or minimal performance objectives. Group II and III objectives are higher order performance objectives.

the development of the General Information Booklet, Continuous Uniform Evaluation System, and the Master Plan for Implementation of a Continuous Uniform Evaluation System.

The development of the materials and procedures outlined above provide a comprehensive system which can be used to implement a continuous uniform evaluation system in mathematics and which can be used as a model for developing and implementing a continuous uniform evaluation system in other areas. It is the evaluator's position that the quality, scope, and exportability of the materials and procedures which have been developed are more than sufficient to substantiate that the objectives have been accomplished.

Program Implementation

The MAM was implemented within two high schools in the Phoenix Union High School System in 1974-75. Comments contained in the 1974-75 Final Evaluation Report on the implementation of the MAM included:

The Evaluator visited MAM classes at Browne and Alhambra High Schools. The Evaluator was very impressed with the rapport between the MAM teachers and the students. In addition to the positive atmosphere in the classrooms the following observations were made:

(1) Students were using Math Paths which were appropriate for their levels of achievement.

(2) The general strategy of assessing students' level, designing learning activities which are commensurate with students' level, and assessing students' progress was carried out.

(3) Students were grouped with others who were working on similar topics or areas.

(4) Teachers provided students with individual assistance as well as small group instruction.

(5) Students used a variety of activities in acquiring and reinforcing computation skills and concepts.

(6) Commitment sheets were completed by students.

(7) Although students were grouped according to similar levels, there were individual differences and needs among the students within groups. Consequently, a large portion of the instruction was on a one-to-one basis.

It is the Evaluator's belief that one of the positive benefits of the MAM Program is that students actually never fail. If a student has not earned enough points for a passing score at the end of a grading period, he has the opportunity to complete the necessary requirements during the next grading period. In contrast to traditional methods, students do not have to repeat all the tasks that have already been mastered if the credit isn't earned at the end of the grading period. Instead, the students can earn whatever additional points are necessary and can conceivably earn credit for the last grading period and the present period.

The MAM program was continued in 1975-76 at one high school and expanded within that high school to include two additional teachers. The teachers expressed satisfaction with the MAM during, and at the end of the school year. A positive finding in 1975-76 was the degree to which the MAM was implemented and revised to meet the individual needs or styles of each teacher without a great amount of inservice training. In other words, a teacher with one year of experience in the MAM and a teacher new to the MAM were able to work in a team and implement the MAM with little outside assistance. This suggests that the MAM is exportable and can be implemented with a very minimum of

pre-service or inservice training once a cadre of experienced teachers are available to assist those new to the system.

The MAM program was discontinued at the second high school in 1975-76. This is probably evidence that the MAM is not ammendable to all teaching styles or school situations. However, the teachers who chose not to continue with the MAM were not critical of the MAM per se but indicated a preference for developing their own instructional programs and possibly using some of the MAM concepts. As opposed to a weakness, this can also be viewed as a strength of the MAM in that teachers can use all or some of the concepts, materials, and techniques in order to accomplish individual goals and objectives within their own teaching styles and situations.

Interest in the MAM is continuing as evidenced by a request for additional MAM classes for 1976-77. Thus, the MAM has been implemented and has begun to grow in the number of teachers and students who elect to participate. As discussed in the previous section, the necessary materials, program descriptions, and procedures are available for those desiring to implement the MAM.

Effectiveness

The effectiveness of the MAM was assessed in a product evaluation in 1974-75. Students in MAM classes made significantly greater gains than comparable students not in MAM classes. The means and standard deviations for the MAM and two comparison groups are contained in Table 1. It is evident that the MAM students made greater gains than either of the two comparison groups. The number of classes, teachers, and schools sampled was sufficient, given the usual assumptions of comparability of

testing and measurement settings, to insure that these results were attributable to the effects of the MAM. Substantial information was obtained to support the conclusion there was probably no interaction between the type of students who chose to enroll in the MAM classes and the gains made.

Table 1

Means and Standard Deviations of Shaw-Hiehle Test Scores for Three Math Teaching Methods

Teaching Method		Pretest	Posttest	Adjusted Posttest[1]
MAM	Mean	29.0	38.4	38.0
Number=185	Standard Deviation	8.1	9.2	-
Traditional	Mean	28.3	35.3	35.4
Number=150	Standard Deviation	8.1	9.2	-
Math Labs	Mean	27.4	34.3	35.2
Number=59	Standard Deviation	9.4	10.0	-

[1]Adjusted for pretest differences.

Although MAM students did not have significantly more positive attitudes than comparison students, the trend was for MAM students to have more positive attitudes, see Table 2, and if the .10 level of significance had been selected instead of the more stringent .05 level of significance, MAM students would have had signigicantly more positive attitudes.

Table 2

Means and Standard Deviations of Attitude Scores for Three Math Teaching Methods

Teaching Method		Pretest	Posttest	Adjusted Posttest[1]
MAM	Mean	139.1	135.3	134.4
Number=166	Standard Deviation	13.9	19.4	-
Traditional	Mean	135.7	129.9	130.7
Number=150	Standard Deviation	14.5	14.9	-
Math Lab	Mean	135.6	130.2	131.0
Number=50	Standard Deviation	15.1	15.1	-

[1]Adjusted for pretest differences.

Analyses of the MAM attitude questionnaire indicated that the scales were fairly reliable. The split-half reliabilities were .84 and .73 for the pretest and posttest respectively. Thus, it appears the MAM attitude scales are reliable measures of students' attitudes toward learning mathematics.

The overall questionnaire reliability was reduced in subsequent analyses in which 10 "bad items", as defined by low item reliabilities, were deleted from the 40-item scale. If the questionnaire was to be used in the future, it is recommended that items with low reliabilities be replaced with revised or new items to insure that the reliability of the questionnaire does not decrease due to a fewer number of items.

Another objective for the MAM was to improve the attendance of students. The attendance of students was not affected by the MAM program. However, an encouraging finding was that the proportion of students withdrawing from the MAM classes was lower than the proportion of students withdrawing from the comparison classes.

In summary, the MAM has a positive impact on students' achievement and at the same time encourages each student to work on those skills specific to his/her needs.

Preparation and Organization of Materials and Program Descriptions

Materials have been developed and organized throughout the three years of the MAM. A major effort was made in 1974-75 to organize the MAM materials into a system which was readily usable for anyone wishing to review the MAM program structure. In 1975-76 the primary focus of activity for the MAM Coordinator and Assistant Coordinator was the development of the General Information Booklet, and the Master Plan for Implementation of a Continuous Uniform Evaluation System. Thus, the major objectives to develop and to make available systems which could be used to provide information about the MAM and to assist others with implementing the MAM were accomplished.

In addition to the material cited above, a complete set of goals and specific objectives for a K-12 computational skills program were also developed. The materials and manuals which have been developed provide the content and necessary steps to implement an individualized mathematics program. It is anticipated that anyone who desires information about the MAM, is interested in implementing the concepts, or wishes to use the curriculum which has been produced, will have the necessary documents to assist them in accomplishing this goal.

Summary and Recommendations

The MAM Project has succeeded in the development, implementation, evaluation, and dissemination of a completely individualized learning program for basic and higher order math skills. The project staff is to be commended on the quality and scope of materials which have been developed and orgainzed into a usable system. In fact, the MAM has been chosen by the National Council of Mathematics Teachers as a model individualized instructional program.

The success of the MAM can be illustrated by noting two areas. First, the number of MAM classes requested at Browne High School has increased each year the program has been at Browne. Second, the evaluation of the MAM impact on student achievement indicated that the program assists to improve students' learning and attitudes. Thus, student interest and achievement in the MAM Project are well documented exemplars of its success.

It is recommended that the Phoenix Union High School System and the Arizona State Department of Education continue to support the expansion of the MAM to other schools and districts. The MAM can be recommended as an effective individualized learning program that provides for a continuous uniform evaluation system in basic and high order mathematics skills.

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